

WHAT IS CLAIMED IS:

1 1. An isolated origin of replication for *F. nucleatum* that comprises at
2 least two copies of an iteron, the iteron having a nucleic acid sequence of SEQ ID NO:3.

1 2. The isolated origin of replication of claim 1, wherein the isolated
2 origin of replication comprises two to six copies of the iteron.

1 3. The isolated nucleic acid of claim 1, wherein the isolated origin of
2 replication comprises a nucleic acid sequence of SEQ ID NO:4.

1 4. The isolated nucleic acid of claim 1, wherein the isolated origin of
2 replication comprises a nucleic acid sequence of nucleotide position 3936 to 4481 of
3 plasmid pFN1.

1 5. An isolated nucleic acid encoding a RepA protein for *F. nucleatum*,
2 the nucleic acid:

3 (a) encoding a protein that has greater than about 80% amino acid
4 sequence identity to a polypeptide having a sequence of SEQ ID NO:1; or

5 (b) selectively binding to polyclonal antibodies generated against SEQ
6 ID NO:1.

1 6. The isolated nucleic acid of claim 5, wherein the nucleic acid
2 encodes a polypeptide having a sequence of SEQ ID NO:1.

1 7. The isolated nucleic acid of claim 5, wherein the nucleic acid
2 encodes a polypeptide having a molecular weight of about 44.8 kDa.

1 8. The isolated nucleic acid of claim 5, wherein the nucleic acid is
2 from *F. nucleatum*.

1 9. The isolated nucleic acid of claim 5, wherein the nucleic acid has a
2 sequence of SEQ ID NO:2.

1 10. An isolated nucleic acid molecule comprising a 2.36 kb DNA
2 fragment generated by cleaving plasmid pFN1 with restriction endonucleases *AvrII* and
3 *ScaII*.

- 1 11. An isolated nucleic acid molecule comprising a 0.9 kb DNA
2 fragment generated by cleaving plasmid pFN2 with restriction endonucleases *HincII* and
3 *HpaII*.
- 1 12. An isolated RepA protein for *F. nucleatum*, the RepA protein
2 having:
3 (a) greater than about 80% amino acid sequence identity to a
4 polypeptide having a sequence of SEQ ID NO:1; or
5 (b) selectively binding to polyclonal antibodies generated against SEQ
6 ID NO:1.
- 1 13. The isolated RepA protein of claim 12, wherein the polypeptide
2 has greater than about 97% amino acid identity to a polypeptide having a sequence of
3 SEQ ID NO:1.
- 1 14. The isolated RepA protein of claim 12, wherein the polypeptide
2 has the amino acid sequence of SEQ ID NO:1
- 1 15. An isolated plasmid for replicating in *F. nucleatum*, the plasmid
2 comprising an origin of replication that comprises at least two copies of an iteron, the
3 iteron having a nucleic acid sequence of SEQ ID NO:3.
- 1 16. The plasmid of claim 15, wherein the origin of replication
2 comprises between two to six copies of the iteron.
- 1 17. The plasmid of claim 15, wherein the origin of replication
2 comprises a nucleic acid sequence of SEQ ID NO:4.
- 1 18. The plasmid of claim 15, the plasmid further comprising a marker
2 gene.
- 1 19. The plasmid of claim 18, wherein the marker gene is an antibiotic
2 resistance gene.
- 1 20. The plasmid of claim 15, wherein the origin of replication is
2 recombinantly inserted into the plasmid.

1 21. An isolated plasmid for replicating in *F. nucleatum*, the plasmid
2 comprising a nucleic acid encoding a RepA protein for *F. nucleatum*, the nucleic acid:
3 (a) encoding a protein that has greater than about 80% amino acid
4 sequence identity to a polypeptide having a sequence of SEQ ID NO:1; or
5 (b) selectively binding to polyclonal antibodies generated against SEQ
6 ID NO:1,
7 provided that the nucleic acid encoding the RepA protein has other than
8 the nucleic acid sequence of SEQ ID NO:5.

1 22. The plasmid of claim 21, wherein the nucleic acid encodes a
2 polypeptide having a sequence of SEQ ID NO:1.

1 23. The plasmid of claim 21, wherein the nucleic acid has a sequence
2 of SEQ ID NO:2.

1 24. The plasmid of claim 21, the plasmid further comprising a marker
2 gene.

1 25. The plasmid of claim 24, wherein the marker gene is an antibiotic
2 resistance gene.

1 26. The plasmid of claim 20, wherein the nucleic acid encoding a
2 RepA protein is recombinantly inserted into the plasmid.

1 27. The plasmid of claim 15, the plasmid further comprising a nucleic
2 acid encoding a RepA protein for *F. nucleatum*, the nucleic acid:

3 (a) encoding a protein that has greater than about 80% amino acid
4 sequence identity to a polypeptide having a sequence of SEQ ID
5 NO:1; or
6 (b) selectively binding to polyclonal antibodies generated against SEQ
7 ID NO:1,
8 provided that the nucleic acid encoding the RepA protein has other than
9 the nucleic acid sequence of SEQ ID NO:5.

1 28. The plasmid of claim 27, wherein the nucleic acid encodes a
2 polypeptide having a sequence of SEQ ID NO:1.

1 29. The plasmid of claim 27, wherein the nucleic acid has a sequence
2 of SEQ ID NO:2.

1 30. The plasmid of claim 27, the plasmid further comprising at least
2 one marker gene.

1 31. The plasmid of claim 30, wherein the marker gene is an antibiotic
2 resistance gene.

1 32. The plasmid of claim 27, the plasmid further comprising a
2 transcription cassette comprising a nucleic acid of interest operably linked to a promoter.

1 33. An isolated plasmid for replicating in *F. nucleatum*, the plasmid
2 comprising:

3 (a) a nucleic acid sequence of nucleotide position 3936 to 4481 of
4 plasmid pFN1;

5 (b) a 2.36 kb DNA fragment generated by cleaving plasmid pFN1 with
6 restriction endonucleases *AvrII* and *ScaII*; or

7 (c) a 0.9 kb DNA fragment generated by cleaving plasmid pFN2 with
8 restriction endonucleases *HincII* and *HpaII*.

1 34. An isolated plasmid designated pFN1 that has a GenBank
2 Accession No. AF159249.

1 35. An isolated plasmid designated pFN2 that have partial restriction
2 maps as shown in Figure 1A, 3 and 5.

1 36. An isolated plasmid designated pFN3 that has a partial restriction
2 map as shown in Figure 1A.

1 37. A shuttle vector comprising an origin of replication functional in *E.*
2 *coli* and an origin of replication functional in *F. nucleatum*, wherein the origin of
3 replication functional in *F. nucleatum* comprises at least two copies of an iteron having a
4 nucleic acid sequence of SEQ ID NO:3.

1 38. The shuttle vector of claim 37, wherein the origin of replication
2 functional in *F. nucleatum* comprises between two to six copies of the iteron.

1 39. The shuttle vector of claim 37, wherein the origin of replication
2 functional in *F. nucleatum* comprises a nucleic acid sequence of SEQ ID NO:4.

1 40. The shuttle vector of claim 37, wherein the origin of replication
2 functional in *F. nucleatum* comprises a nucleic acid sequence of nucleotide position 3936
3 to 4481 of plasmid pFN1.

1 41. The shuttle vector of claim 37, the vector further comprising a
2 nucleic acid encoding a RepA protein for *F. nucleatum*, the nucleic acid:

3 (a) encoding a protein that has greater than about 80% amino acid
4 sequence identity to a polypeptide having a sequence of SEQ ID NO:1; or

5 (b) selectively binding to polyclonal antibodies generated against SEQ
6 ID NO:1.

1 42. The shuttle vector of claim 41, wherein the nucleic acid encoding
2 the RepA protein for *F. nucleatum* encodes a polypeptide having a SEQ ID NO:1.

1 43. The shuttle vector of claim 41, wherein the nucleic acid encoding
2 the RepA protein for *F. nucleatum* has a sequence of SEQ ID NO:2.

1 44. The shuttle vector of claim 41, the vector further comprising at
2 least one marker gene.

1 45. The shuttle vector of claim 44, wherein the marker gene is an
2 antibiotic resistance gene.

1 46. The shuttle vector of claim 41, wherein the vector comprises an
2 *ermF-ermAM* cassette.

1 47. The shuttle vector of claim 41, the vector further comprising a
2 transcription cassette comprising a nucleic acid of interest operably linked to a promoter.

1 48. A shuttle vector designated pHS17 that has a partial restriction map
2 as shown in Figure 1A.

1 49. A host cell comprising the plasmid of claim 18.

1 50. The host cell of claim 49, wherein the host cell is *F. nucleatum*.

- 1 51. A host cell comprising the plasmid of claim 24.
- 1 52. The host cell of claim 51, wherein the host cell is *F. nucleatum*.
- 1 53. A host cell comprising the plasmid of claim 30.
- 1 54. The host cell of claim 53, wherein the host cell is *F. nucleatum*.
- 1 55. A host cell comprising the shuttle vector of claim 37.
- 1 56. The host cell of claim 55, wherein the host cell is *F. nucleatum*.
- 1 57. The host cell of claim 55, wherein the host cell is *E. coli*.
- 1 58. A method of transforming a *F. nucleatum* with the plasmid of
2 claim 21.
- 1 59. A method of transforming a *F. nucleatum* with the plasmid of
2 claim 15.
- 1 60. A method of transforming a *F. nucleatum* with the plasmid of
2 claim 21.
- 1 61. A method of transforming a *F. nucleatum* with the plasmid of
2 claim 27.
- 1 62. A method of transforming a *F. nucleatum* with the shuttle vector of
2 claim 37.
- 1 63. A method of transforming an *E. coli* with the shuttle vector of
2 claim 37.